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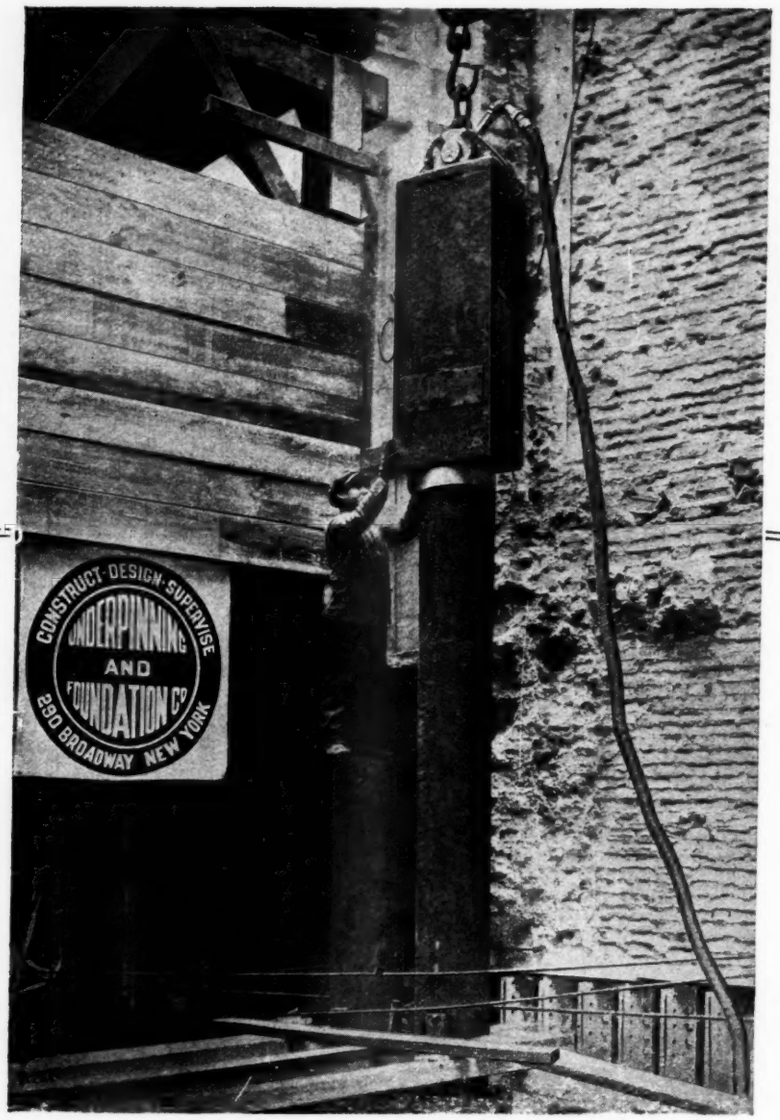

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Vol. 49 FLORAL PARK, NOVEMBER 13, 1920 No. 20

Macadam Base for Bituminous Pavements*

The author discusses the factors affecting the strength and durability of pavements on macadam base, including strength of base, supporting power of the earth, and the traffic to be carried. He also calls attention to undesirable practices, especially insufficient protection of shoulders.

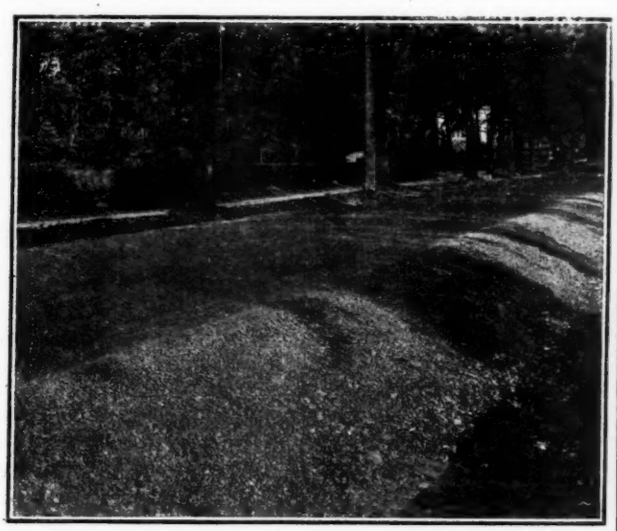
The following advantages have been claimed for the use of macadam as a foundation under asphalt pavements of various kinds:

1. Economy in utilizing existing macadam pavements.
2. Lower cost (depending upon available materials, labor rates, etc.) of construction of new macadam base as compared to Portland cement concrete.
3. Freedom from the transverse cracks that develop in bituminous surfaces on Portland 'cement concrete due to the contraction and 'cracking of that type of base.
4. Slight resiliency of the macadam base, which reduces the hammering or anvil effect produced upon an asphalt surface laid on unyielding base.

As an illustration of opinions from disinterested sources, a city engineer of a southern town states that bitulithic stays put on a macadam base very much better than on concrete; that a properly prepared macadam foundation is quite elastic, absorbing a considerable portion of the shock of heavy auto trucks and in throwing the entire burden of impact upon the wearing surface. Numerous similar views held by engineers could be cited.

In contrast to this viewpoint is the growing tendency in some localities to disregard the possible value of macadam road as a base, usually

*Abstract of paper by Julius Adler, technical engineer, Atlantic Refining Company, before American Society for Municipal Improvements.



DEEP SIDE DITCH AND VERY NARROW BERM
Danger of Breaking Down at Sides Under Truck Traffic in Periods of Wet Sub-Grade

PREPARED MACADAM BASE
Clean, Slightly Rough Surface, About 22 Feet Wide, for 18-Foot Asphalt Surface

because it is considered inadequate under all year round heavy motor truck traffic. This opinion is supported by reports from a number of localities of serious damage to both macadam roads proper and macadam based types during the winter of 1919-1920. In view of the wide variations in climatic and other local conditions, in volume and weight of traffic, broad statements in regard to either the merit or lact of merit of such construction should be accepted with caution since success or failure in any particular case may be attributed to strictly local conditions.

To determine the limitations of a given type of paving construction it is necessary first to establish the factors affecting the strength and durability and, second, the application of these factors to a specific case. For the type under consideration, the factors are

1. Strength of base.
2. Variation in supporting power of the earth subgrade.
3. Volume and weight of traffic.

STRENGTH OF BASE

Under this heading come such elements as the total depth and degree of consolidation of the base, the size of the units used as aggregate, and the strength and durability of the aggregate.

Other things being equal, the greater the depth of base, the greater the area of sub-base over which the road is transmitted.

Consolidation refers to the thoroughness with which the pieces of aggregate have been forced into place during construction and by the action of traffic; it being generally conceded that traffic affects this more reliably than rolling alone.

Under size of aggregate units must be considered the relative value in the base of stone 1½ inches in diameter or less, ballast-size stone and large pieces such as used for Telford base, respectively. Results in general point very closely to the greater value of the base employing the largest possible size of aggregate, which affords greater stability, better distribution of loads, freer drainage and less disturbance by frost

Strength and durability refer to the quality of the aggregate material, whether soft, shaley, porous or dense and tough. It is generally well established that base material does not need to be so hard and tough as that in the wearing surface.

VARIATION IN SUPPORTING POWER OF THE EARTH SURFACE

This is a factor which causes the most serious damage. The supporting power is affected primarily by the character of the soil, natural and artificial provisions for drainage, and climatic conditions such as amount of rain and snow fall, depth of frost action and likelihood of alternate freezing and thawing.

Under the light traffic of years ago a macadam road developed a surprising beam strength, but with present truck traffic beam strength must be considered as nearly negligible and there must be reasonable assurance of nearly uniform support by the subgrade itself. On free draining soils, generally sandy or gravelly, very light macadam base has carried considerable traffic with entire success. Where natural drainage is poor, artificial drainage is absolutely essential. Everyone seems to realize this but comparatively few to carry out the ideas in practice. There will undoubtedly be some conditions such as heavy clay soil in flat sections subject to severe frost action where no prevailing method of drainage will give the subsoil sufficient strength.

Alternate freezing and thawing are especially detrimental. Numerous conditions can be cited where the temperature remains uniformly low enough in winter to keep the earth frozen continuously and prevent the percolation of water into the soil during this period, where the roads have stood up successfully. The critical time under such conditions is when the frost leaves the ground in the spring.

VOLUME AND WEIGHT OF TRAFFIC

For macadam base, probably the most important point in connection with traffic is that of the likelihood of the use of the road by heavy concentrated roads during the winter and the spring. In sections where traffic practically disappears through the winter and does not reappear in quantity until the subgrade is pretty well dried out in the spring, the damage by heavy traffic may be relatively slight. In general, the most severe damage is found in localities where heavy motor trucks use the roads throughout the year and especially during February, March and April.

SUGGESTIONS FOR IMPROVEMENTS

Assuming the above to be a correct analysis of the factors in the supporting power of macadam, the problem remains of applying these to individual cases and attempting to determine in advance which ones would be apt to shorten the life of the foundation and the overlying pavement.

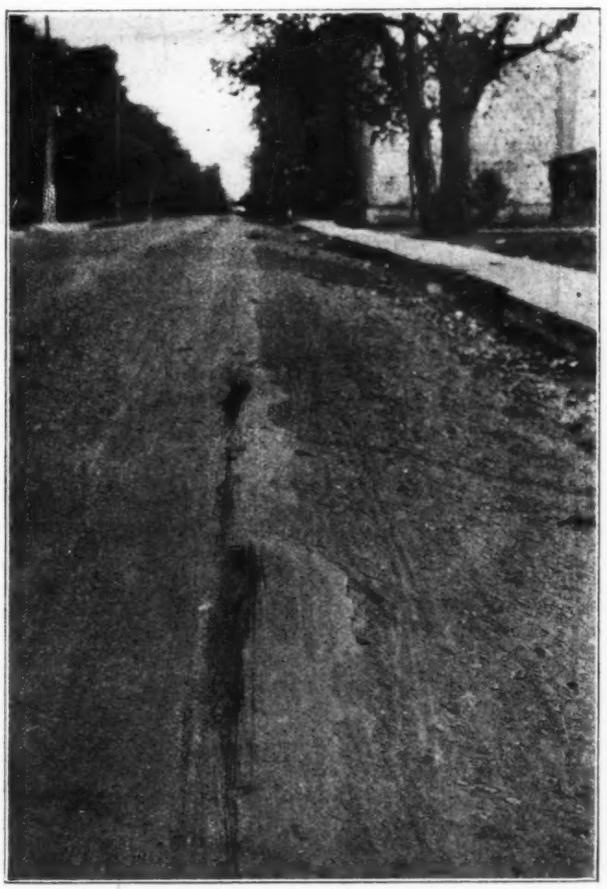
Recent recommendations for this type of base vary from 4 to 12 inches depending on individual opinion as well as soil and drainage conditions. There has been a tendency to overestmate the depth of existing macadam arising largely from failure to realize that, while additional stone has been added year by year to the surface, an equal or even greater amount may be worn off meantime by traffic. Before using an old road, the depth at numerous points should be determined by test holes, which also will indicate the character of the existing aggregate. In general it is believed that where an old road contains 6 or 8 inches of compacted stone it is well worth saving. But no radical view should be adopted as to the minimum thickness of base that will support a proposed pavement. The writer believes however that 4 to 6 inches is not sufficient in the north eastern section of the country, especially near large cities. Even where ample depth is found, it is usually desirable to add a uniform layer of ballast-size aggregate, first scarifying the surface, the new aggregate serving to elevate the proposed bituminous pavement above the old base which, owing to the large amount of dust and fine materially usually contained, is very

apt to hold considerable moisture at certain periods of the year. While this disturbs the top 2 or 3 inches of the old consolidated road, an old road which will not stand disturbance for this depth will generally not have depth adequate for use as a foundation in any case. Moreover, the greater regularity of contour of a base to which new aggregate has been added will add to the life of the bituminous pavement more than enough to offset the slightly more consolidated but irregular base which is apt to produce irregularity in the pavement surface. By admitting traffic under restrictions over the newly placed aggregate before applying the surface material, consolidation can be completed.

In utilizing existing macadam as a base, at least as much provision should be made for drainage as though an entirely new piece of road were being built. Too frequently this is not done, but shallow ditches, ditches too close to the improved surface, sections requiring special drainage, etc., are allowed to remain unimproved.

One type of failure of macadam base has been the squeezing out and breaking up of the sides due to a combination of too little lateral support at the shoulders, the softening of the subgrade under the edges of the pavement due to the entrance of water, and in general a failure to recognize that the sides of the road are thinner and weaker than the central portion. It is believed that the thoroughly consolidated base of full depth should always extend at least 18 to 24 inches beyond the edge of the pavement laid upon it. This will furnish much greater resistance to the thrust on the foundation from heavy loads travelling slowly on the sides of the road than is now encountered; provided, however, that the improved road is not so narrow that heavy traffic is constantly cutting off and on it.

As a further improvement, the shoulders should be water proof and support furnished at the edges of the bituminous pavement. Cases have been noted where the existence of an old macadam shoulder, even though rather thin, has been of material benefit. Well built stone block or rubble gutters and headers produce a similar result. If no better provision can be made, stone removed from the old surface can be used to harden the shoulders and additional aggregate brought in where required. One of the best practices for country roads is the construction of bituminous macadam wings three or more feet wide which provide water proofing and lateral support to the pavement and at the same time furnish a hardened surface capable of carrying occasional loads. At least there should be on each edge a strip of hardened surface 18 to 24 inches wide like the base previously referred to. This may be criticized as calling for a greater width of road and consequent cost than would be required if some other type of construction were used, but in its support it may be said that the change from the approved width of 15 feet of a few years ago to the present demand for 20 feet as being desirable, points unmistakably to the necessity for providing ample width at the outset. Also roads of other types built 16 to 18 feet wide



EFFECT OF WEAK SHOULDER, CHIEFLY DUST
Lack of Support Permits Spreading of Pavement Under Heavy Truck Traffic

will eventually need protecting wings for the preservation of the pavement, inasmuch as a sudden drop off from a hardened surface to a soft earth or clay shoulder is objectionable from several standpoints. If too close to the edge of a pavement, open ditches allow moisture to get under the base and reduce the support, while if far away, leaving a wide unwaterproofed shoulder, there is too much opportunity for the entrance of water through the surface, especially when it is heavily blanketed with snow or ice. For country roads a shoulder of about five or six feet wide is recommended, waterproof between the edge of the road and a point near the edge of the ditch.

Missouri Highways

The Federal Road Council of St. Louis has a plan for the construction of 43 miles of 20 feet wide hard-surface roads in Missouri as soon as materials are available. The secretary and manager of the council urges support for the proposed $60,000,000 state road bond issue that is to be voted on in the November election and explains that if this sum is secured it is intended to build 6,000 miles of hard roadways in Missouri immediately and that it is planned to accomplish this without direct taxation by providing for it from state fees for automobile license.

Specifications for Broken Stone Foundations

The latest approved methods of building new macadam base or utilizing old for bituminous surfaces given in the form of specifications by a committee of the American Society for Municipal Improvements.

These specifications were prepared by Linn White, chief engineer, Chicago South Park Commission, and a member of the Committee on Foundations for Pavements of the American Society for Municipal Improvements, and was presented at the St. Louis convention of that society as a progress report of the committee.

SUB-GRADE

In the case of the construction of new broken-stone foundations for pavements the sub-grade shall be prepared by cutting or filling as may be required to produce a surface parallel with the finished grade of the wearing surface and a distance below the finished grade equal to the specified thickness of the foundation and paving material.

The sub-grade shall be brought to a firm, unyielding surface by rolling the entire area with a three-wheel road-roller weighing at least ten tons, and all portions of the surface of the sub-grade which are inaccessible to the roller shall be thoroughly tamped with a hand tamper weighing not less than forty pounds, the face of which shall not exceed eighty (80) square inches in area. All soft, spongy, or yielding spots and all perishable matter shall be entirely removed and the space filled with suitable material.

When considered necessary or of assistance in producing a compact, solid surface the sub-grade before being rolled shall be sprinkled with water.

SUB-DRAINAGE

When the soil is of such a character that it retains an excessive amount of moisture, such as clay subject to swelling or heaving under the action of frost, or sands similar to quicksand that do not afford a ready natural drainage, sub-drains should be provided.

These may be of two general kinds, first, tile drains of open porous material or vitrified tile laid with open joints; second, trenches filled with broken stone, gravel, cinders or other similar material.

In some cases it may be sufficient to construct a sub-drain on each side of the roadway at or near the lines of the gutters, but when the soil is of a very wet nature, it may be advisable to lay additional lines of drains which may be in or near the middle of the roadway. This system of drains may be varied by diagonal lines of drains running from near the crown of the roadway to the gutters.

In all cases the drains should have connections with the existing sewers, catch basins or inlets.

NEW MACADAM FOUNDATION

If the pavement is to be laid on a new macadam foundation, the macadam shall be built as follows:

The total thickness of the macadam base will vary according to character of soil, drainage, kind of stone available, etc. In general the macadam base should be constructed of broken stone which is sound, hard and durable under traffic. The broken stone should be separated into different sizes by screening, the smaller sizes with the dust being used to fill and bond together the larger sizes. The thickness of the base should be regulated by experience in constructing ordinary water-bound macadam roads in similar situations, the total thickness of base being made the same or a little less than well-constructed macadam.

After the sub-grade has been properly prepared, spread a layer of clean stone passing a three (3) to three and one-half (3½)-inch revolving screen and held on a two (2)-inch screen to a depth sufficient when thoroughly rolled to form about two-thirds (⅔) of the total thickness of the base. The thickness of this layer should be regulated by laying on the sub-grade at proper intervals cubical blocks of wood of the proper dimensions to give the desired thickness or regulated by other means approved by the engineer. Over this layer of stone, spread with shovels stone screenings in sufficient quantity to fill the voids between the larger stone. The screenings should be spread gradually, and be thoroughly rolled with a road roller weighing at least ten (10) tons during the process of spreading the screenings. As the screenings are worked into the coarse stone under the roller, more should be added here and there where voids appear. At first the rolling should be done dry (working from the edges towards the center of the roadway), until the stone appears to be well filled, then the surface should be well sprinkled and again rolled, the rolling and sprinkling continuing until the layer of stone is thoroughly compacted and no more screenings can be worked in. Just enough screenings shall be used to fill and bond the stone, leaving no surplus screenings on the top.

The above method may be varied by using the crusher-run of stone without the addition of any other filler where the small sizes are not in excess. Also a filler other than stone screenings, such as bank gravel or sand may be used in some cases where experience with the materials available shows that better results can be obtained. Under some conditions, the character of soil and stone available may be such as not to require the use of any filler with the stone of the first course. The specifications given, however, represent the best average practice where stone with bonding value, such as limestone or trap rock, can be obtained.

When the first layer of macadam is completed as specified, spread a second layer of clean stone passing a two (2)- or two and one-half (2½)-inch screen and held on a one (1)-inch screen to a depth sufficient when thoroughly rolled to form the remaining one-third (⅓) of the total thickness of the base. Over this layer of stone spread

evenly with shovels stone screenings and roll with the application of water by sprinkling until the layer of stone is well filled, well bonded and firmly set in place. In the case of bituminous pavements just enough filler should be used to accomplish this purpose and not enough to form a layer or film over the surface of the stone. In fact, it is better not to fill the stone quite flush, leaving the coarse particles of stone slightly projecting, so as to have a coarse, grainy base upon which to put the wearing surface. In the case of block or brick pavements, enough screenings should be used to produce a smooth, evenly filled surface.

The thickness of the base should vary according to local conditions and should be fixed by the engineer in charge when all the varying conditions of soil, drainage, traffic and materials of construction are understood. In general, a thickness of macadam base of eight inches will be enough for any except the most adverse conditions, and a base of four to four and one-half inches will meet the most favorable conditions of firm, unyielding soils and light traffic.

OLD MACADAM FOUNDATION

If the pavement is to be laid on an old macadam base, the surface should be thoroughly swept and cleaned of all fine material that may be caked upon the surface of the stone or lying loose as dust, thereby exposing the clean coarse stone for the reception of the bituminous concrete.

If the old macadam does not present the desired coarse, grainy surface, or is not at proper and satisfactory grade after cleaning, it shall be spiked up and redressed to the desired crown and grade, the coarse stone being brought to the top by harrowing or otherwise, or new stone added when, in the opinion of the engineer in charge, it is needed to give the necessary thickness or character of surface. It shall then be thoroughly rolled with the use of water as may be required.

In the case of bituminous pavements a layer about one stone deep of new, clean stone, averaging one and a half (1½) inches in size, shall be spread over the surface after redressing and rolling the old macadam, and finally rolled until firmly set in place without the application of water. This is intended to form a coarse, grainy surface of fresh clean stone which will bond with the bituminous paving material.

Discussion of Macadam Base For Bituminous Pavement

In discussing the two previous papers, Mr. Warren suggests seven rules for planning the use of old macadam.

The following is an abstract of a written discussion on this subject presented at the convention of the American Society for Municipal Improvements by George C. Warren, president of Warren Brothers Company. Mr. Warren has for ten years urged and successfully practiced the use of old macadam roads as a foundation for bituminous surfaces, but realizes the limitations. The macadam must be real macadam of stone or gravel and of substantial strength and depth or must be reinforced with new stone compressed into it. It should not be tried with a pavement composed of a small percentage of stone or gravel in a large percentage of clay or other weak material nor with a veneer of indifferently spread stone on a weak subsoil. On the other hand, in nearly all cases where any stone or gravel has been spread and compressed on the subgrade.

RESULT OF POOR DRAINAGE—ASPHALT BLOCK PAVEMENT ON SIX-INCH CONCRETE BASE
The Trouble Was Not Due to Either Wearing Surface or Base, But to Insufficient Drainage. Note That the Road Bed is Several Inches Below the Adjoining Property

there is at least a great salvage value which should be conserved.

In city streets, especially those having street railroads, it is sometimes necessary to remove some of the old macadam to prevent raising the gutters too high at the curb or the pavement too high next to the railroad track. This will not often be the case however, if the engineer does not attempt to provide an exposed face of curb higher than is necessary. In some cases a few additional catch-basins may be necessary to reduce the flow of surface water in the gutter, but that can be provided at only a fraction of the cost necessary to remove the old macadam as a whole or in part. In constructing country roads, the raising of the elevation of the pavement is advantageous rather than detrimental.

For planning this use of macadam he suggested a few rules:

1. Never depend on surface appearance nor even on test excavations made a few weeks or months before construction to determine whether or not the old macadam will require reinforcement.

2. Make test holes (or better, test cuts across the street or road) at intervals of about 100 feet immediately in advance of construction and from these determine the necessity for new metal to provide the necessary strength of base, which will doubtless vary on different sections of the same project. The quantity cannot be definitely determined in advance and consequently should be paid for by the ton or cubic yard of new material actually used, and bids asked on that basis.

3. Do not disturb the old macadam by change of grade or contour or by scarifying unless absolutely necessary. Any disturbance more or less reduces the strength and consequently the conservation value of the old macadam and sometimes actually removes practically all of it in the center of the road. If the crown is excessively high, better correct by building up the quarters and outer edges with new metal than to remove solid road metal from the center, unless there is a greater depth of solid macadam in the center than is necessary.

4. However thin or weak the road metal on the street, it is better to leave it and use it for all it is worth than to remove it.

5. If test excavations develop 6 inches or more of solid metal (whether gravel or crushed stone) in which the coarse particles from ¼ inch to 2 inches constitute more than one-half the total metal so that the finer particles merely fill the voids, then no treatment is necessary or advisable except to regulate the grade, knocking off the high points and filling in the low places by scarifying, using picks in the roller wheels, or hand picks, whichever may be most economical in each case, and then thoroughly roll.

6. If the test excavations show that the fine particles predominate or the depth is insufficient on the whole or any part of the street, that condition does not justify removing the material, but after regulating the grade add whatever depth of new metal intelligent consideration of all the conditions indicates as best and safe.

7. If drainage is poor, correct it. Depth and rigidity of base do not correct faulty drainage. On the other hand faulty drainage can be corrected at much lower cost than by destroying old macadam and furnishing new base. Failure to provide drainage is the prime cause of many failures of macadam pavements. The disaster during the past spring thaws was not at all confined to roads with foundations of the macadam type nor to any special type of surface. The trouble was universal throughout New England, New York and elsewhere at places where drainage had been ignored or was faulty. The accompanying illustration of a block pavement surface on Portland cement concrete base illustrates this point. No one who examined this would fairly charge the destruction to type of either surface or base. It was simply faulty drainage. This road is several inches below the abutting land—a condition itself which always invites drainage disaster, as it provides no outlet for surface drainage except to seep under the road. During the spring of 1920 Mr. Warren examined a road which had exploded for a length of about a mile. It was in a rolling country and the middle of the damaged section was at the intersection of two long grades ascending in both directions, with no provision for drainage. One week's thaw in that mile caused $20,000 damage. Not only was there no sub-surface drainage, but a telephone conduit had been laid in the street without even installing lateral drains or weep holes, and during the thaw the conduit became filled with water from the sub-surface, which overflowed through the manholes.

While the writer had had no experience with using macadam base for a block pavement, he advised against it until it had been tested for several years under varying conditions. He feared that the irregularities of surface would prove disastrous; the blocks certainly could not be laid directly on the macadam, and if laid on a cushion of Portland cement over the macadam, the thin cushion would probably be broken up by the traffic. A sand cushion would be more or less irregular in depth and would probably cause the blocks to rock and settle unequally under traffic.

As showing the durability of bituminous surface macadam base, the writer cited the example of Commonwealth avenue, Boston, which was surfaced in 1916 with bitulithic laid over the old macadam without any new metal. Traffic record for twelve hours on Saturday, October 20, of this year, gave 13,316 vehicles and the following Tuesday, 14,120 vehicles. No repairs had been made since the pavement was laid and the present contour and surface are in perfect condition.

Concerning Major Compton's suggested specifications, the writer believes that adding a layer of crushed stone on an old macadam "to form a coarse, grainy surface of fresh, clean stone which will bond with the bituminous paving material" is quite unnecessary, and that new metal should be added only where required to give depth and solidly to the old macadam.

Studies of Flood Discharge of Pine Creek*

In planning for increasing the water supply of Paris, Texas, unusually complete studies were made of the run-off of the catchment area. The designing of the spillway was considered the most important problem, the peak discharge being very high.

By John B. Hawley

During the summer of 1920, the writer studied the water situation of Paris, Texas, looking toward an increased supply.

Although both "Woodbine" and "Trinity-Paluxy" (Antlers formation) sands underlie the city, the former at 400 to 1,200 feet and the latter at 1,900 to 2,700 feet, neither gives artesian flow. The Woodbine water is quite highly mineralized; Trinity-Paluxy is very deep.

Preliminary studies resulted in favor of surface storage.

Pine creek and Sander's creek, tributaries of Red river, were both carefully surveyed. Their

*Paper before the Texas Section, American Society of Civil Engineers.

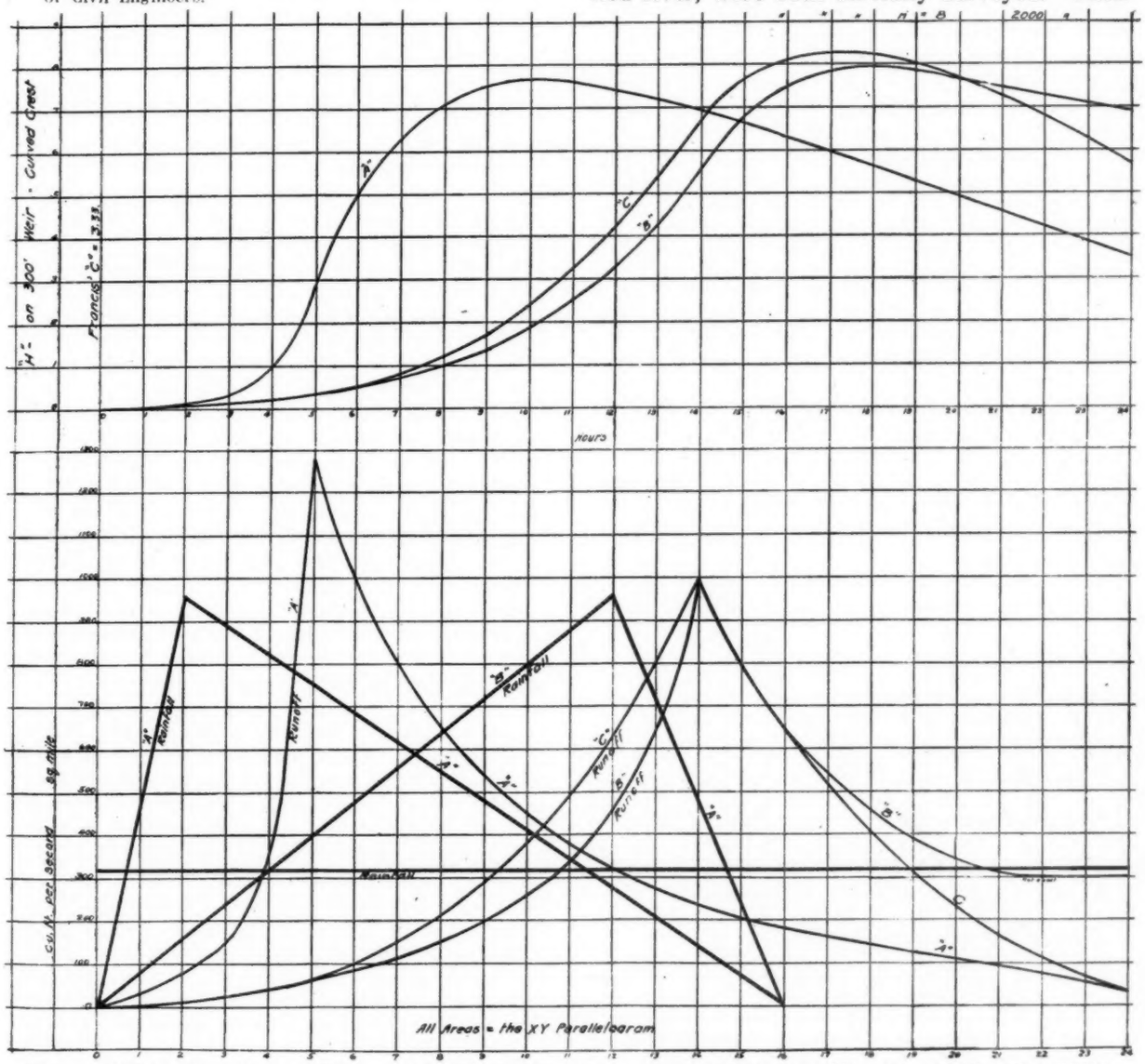


FIG. 2—TOTAL DRAINAGE AREA, 48 SQ. MI. LAKE AREA AT SPILLWAY CREST, 1,400 ACRES; AT 8 FEET ABOVE CREST, 2,000 ACRES

drainage areas lie northwesterly from Paris, and are wholly in the "Eagle Ford" shales. Rainfall records for thirty years are available, but no stream discharge records were found, and observations were made on the very high flood discharges of May, 1920.

Toward the end of the investigation Daniel W. Mead was called into consultation, joining the writer in reporting favorably on Pine creek as the best source of increased supply for the city.

Spillway design appealed to both investigators as the most interesting and difficult problem involved in the research. Tentatively, a concrete spillway, 400-foot width and 8-foot depth of overflow on crest, was included in the estimates, with the statement that more detailed studies would probably reduce the width. The diagrams given indicate 300 feet as the probable safe dimension.

Pine creek, above the selected dam site, has a drainage of 48 square miles, approximately 60 per cent in cultivation. The axial slope of the valley is about 7 feet to the mile; height of divide about 100 feet above dam site, width about 3½ to 4 miles. Soil, detritus of the Eagle Ford clays and shales. (Within the drainage area, the city maintains a lake for water supply purposes, whose drainage area is about four square miles. Lake surface, 220 acres. Capacity, 1,000,000,000 gallons. In the computations below, no account was taken of this lake.) Altitude of the area, about 600 feet above sea level. Area of proposed Pine creek lake, 1,400 acres at spillway level; 2,000 acres at 8-foot depth on spillway. Capacity, about 4,000,000,000 gallons.

Paris lies in the quadrangle bounded by the 95th and 97th meridians, and the 33rd and 35th parallels of latitude. Data published by A. E. Morgan, chief engineer of the Miami Conservation District, shows this quadrangle to have had, at some time, a 24-hour precipitation of 13.3 inches; two days, 14.2 inches; and three days, 14.6 inches. (Hydrology. D. W. Mead, 1919, p. 272.) The rainfall of May 12, 1920, was 4.54 inches at Paris.

Eagle Ford soils, after the early wetting of a driving rain, become "slick" and impervious to a high degree. Thereafter so large a percentage of the downpour runs off that, in the case of the recorded 13.3-inch 24-hour rainfall, the writer has assumed 12 inches of run-off. Similarly, in the case of the 4.54-inch rainfall of May 12, 1920, Mr. Mead assumed practically 100 per cent run-off.

Mr. Mead's analysis of hourly distribution of a 5-inch 24-hour rainfall, and resultant peak flood discharge, is illustrated in Figure 1.

Figure 2 gives the writer's analysis of probable hourly (alternative) distribution of the maximum recorded 24-hour precipitation, with three assumed curves of flood discharge, together with depths on a 300-foot crest with properly designed vertical curves.

Study of Gardner S. William's work on dam crests indicates that the co-efficient "c" in Francis' formula would increase from about 3 to 3.9, but for the purpose of these analyses, and to be ultra-conservative, "c" is assumed at 3.33 throughout.

The writer has failed to develop a formula or set of formulas which would cover the determination of crest depth (lake level), based on inflow of storm water, retention of volume due to expanding storage capacity of the lake, and the discharge capacity of spillway. Several constants were, of course, developed and utilized, but in the main, the computations were by the trial method, gradually approaching exactness. (The writer estimates that probable error is less than 0.1 foot of elevation at each hourly point.)

It is not only possible, but wholly probable, that any one of an infinite number of distribution and run-off curves might be laid for the precipitation analyzed in Figure 2, yet the assumptions used are deemed by the writer to fairly cover the case.

Col. F. W. Scheidenhelm, in his paper on "Reconstruction of the Stony River Dam," Transactions American Society of Civil Engineers, Vol. LXXXI (1917), cites peak flood discharge of the 22-square-mile Cave creek, Bakersville, N. C., drainage area at 1,386 second feet, and the 44-square-mile Elkhorn creek, W. Va., drainage area at 1,363 second feet per square mile. Based on these and other data, and his own observations, Col. Scheidenhelm estimates a peak flood discharge for the 11.4 square miles of the Stony river drainage area to be 1,840 second feet per square mile.

Inasmuch as the Stony river, Cave creek and Elkhorn creek areas all lie more than 3,300 feet above sea level, and in rugged mountainous country, the writer feels that the peak flood discharge of 1,280 second feet per square mile for Pine creek drainage area, with its easy slopes and 600-foot altitude, is reasonably conservative.

The "smoothing" effect of sizeable lakes on peak flood discharge is well illustrated in this analysis. If it be true that the peak in this case is 1,280 second feet, the 48 square miles would give a peak of 61,440 second feet. Figure 2 shows a maximum weir crest depth of 8.32 feet, with discharge of

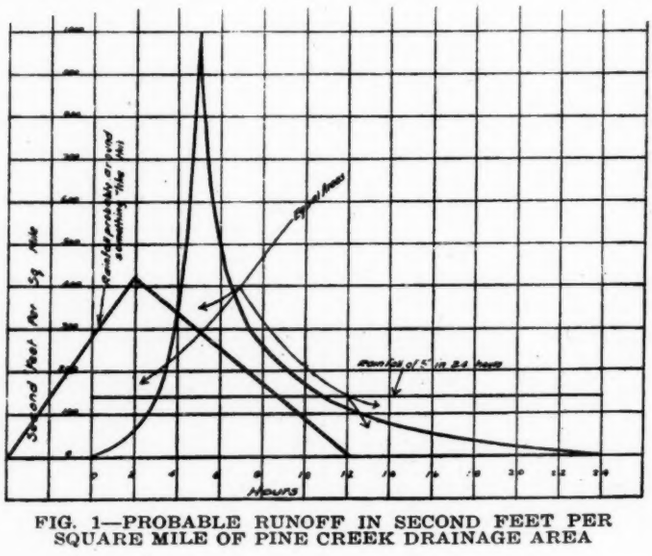


FIG. 1—PROBABLE RUNOFF IN SECOND FEET PER SQUARE MILE OF PINE CREEK DRAINAGE AREA

23,900 second feet. Construction of the dam will doubtless save the "Frisco" Railway trestle and county highway bridge, below the site, the washouts they have frequently experienced.

Lake Worth, from which Fort Worth draws its water supply, has a masonry spillway 700 feet wide, capable of safely carrying a depth of 10 feet. Drainage area, 2,000 square miles, partly hilly and uncultivated. Lake area (at 6½ feet depth on spillway), 5,500 acres. Greatest observed depth on crest of spillway (1914 to 1920), 6.5 feet. Maximum discharge, 40,000 second feet, or 20 second feet per square mile. Average rainfall, 28 inches. Maximum rainfall, 48 inches. This in comparison with Paris' rainfall average, 37 inches; maximum, 60 inches.

Paris and Fort Worth are but 140 miles apart, geographically. Maximum yearly rainfall at Paris is but 25 per cent greater than at Fort Worth. Parts of the Trinity drainage area (Lake Worth) are mountainous compared with that of Pine creek. Multiply the Lake Worth discharge by, say three, in order to arrive at a possible peak flood discharge per square mile, 60 second feet. The Pine creek (probable) peak discharge is 1,280 second feet, twenty-one times as great. Verily, it behooveth the Texas engineer to take thought in spillway design. Beware of small drainage areas with cloudburst proclivities.

Air Pockets and Vacuum Troubles in Gravity Water Mains*

By J. W. Ledoux †

The author describes how such pockets may diminish or entirely stop the flow of water in pipes of irregular profile. Also how best to fill a gravity system.

Nearly every water works superintendent has experienced trouble in connection with some phase of air in pipes. A leaky suction pipe often reduces the plant efficiency materially and sometimes results in serious damage to the pumping machinery.

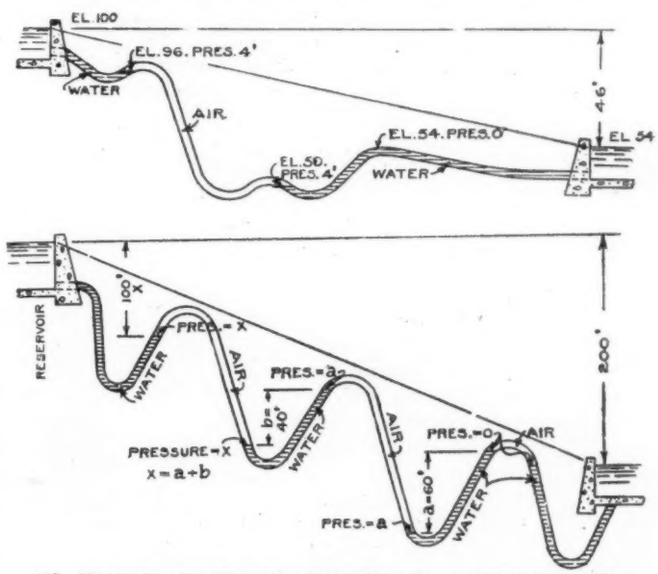
Where the discharge pipe is perfectly tight, if a small quantity of air be pumped with the water, it is likely to accumulate in the summits and appreciably reduce the capacity of the pumping main, or—what is the same thing—increase the frictional head due to the reduced cross-section of the pipe at the summits. The remedy is to prevent the ingress of air at the pumping plant, but even at the best more or less air is entrained with the water, and under reduced pressure at the summits this air may at times accumulate, and then the only remedy is to provide automatic air valves on these summits. However, this difficulty is not common for several reasons. Unless it enters the pumping main in large quantities, it is generally carried along with the water; and if an air obstruction develops, the automatically increased pumping pressure tends to drive it over the summits by attrition. Also, air will escape through apertures too small to show water leaks, and there are usually enough of these to prevent noticeable trouble from pumping discharge mains. This property of air is often the cause of leaks, for in discharging at a high velocity it increases the size of the aperture by washing out fine particles of material that would remain in place if the pipe were full of water.

While the cushioning effect of air in mains often prevents serious water hammer, on the other hand its sudden escape at a high velocity, as sometimes happens, will produce serious water hammer.

The accumulation of air in summits of gravity mains has frequently resulted in the complete interruption of the supply on large portions of the system, and sometimes this phenomenon is troublesome and difficult of correction.

In one case in the experience of the writer a 14-in. main extended from a distributing reservoir, at elevation 628, across a valley, the elevation of which was 150, to the opposite hill at elevation 550, where there was a considerable amount of population, and very variable topography. Branches from this main extended at right angles in both directions to lower elevations. It was found that no water could be furnished on one of these branches, as was evidenced by the complaints of the consumers. The spigots were opened in houses and the water would not flow even at the ground floor. After many hours of investigation, a pocket of air under pressure was discovered at one of the summits, and as soon as this was released the supply was immediately resumed.

Another case consisted of a 16-in. gravity main



NO WATER FLOWING—SYSTEM IN CONDITION OF STATIC EQUILIBRIUM

* Paper read at recent annual convention of New England Water Works Association.

† Consulting Engineer, Philadelphia, Pa.

extending for eight miles from an impounding reservoir to two standpipes supplying a railroad service. It was found one afternoon that no water would flow into the standpipes, and it was immediately assumed that somebody had closed a valve or that the reservoir was empty, because there had not been experienced any trouble since the line was installed several months previously. An inspection was made; air valves were opened all along the mountain at the various summits; no water flowed and no air came out of the main. It was finally learned that on the day before a valve had been closed near the reservoir to make some slight repair on the line; on inquiry it was found that this valve had been reopened and this was verified. It had been the intention to locate automatic air valves at all the summits. One of these summits was close to the impounding reservoir. Finally this air valve was examined and to the surprise of everyone it was found disconnected and lying in the valve pit. On opening the air valve connection, the air escaped and the water began to flow freely. This particular summit was so close to the reservoir and so small as compared with the others on the line that no one suspected that trouble existed at that point

The accompanying diagram illustrates the principle. In this case the impounding reservoir is shown 200 feet above the distributing reservoir, and under these conditions no water can flow through the line until the air is relieved at the summits.

The upper figure illustrates conditions that occurred in the gravity supply to the railroad tanks.

The above examples show conditions of static equilibrium and a balance which is frequently very delicate. This condition is not likely to take place wth pumping mains, where the pressures fluctuate, but is characteristic of fixed levels of water as occur in gravity mains. At least, that has been the experience of the writer.

One of the most important conditions where serious damage can be caused on a pipe line is in the case of a large wood or steel pipe laid over summits and valleys. If, due to water hammer or defect in the pipe, an actual split or break of the pipe takes place in the valley, permitting a large quantity of water to discharge faster than the water can pass over the summit to keep the pipe full, a partial vacuum occurs, and unless the pipe is designed to resist it, collapse will take place. The only remedy for this danger is to maintain a sufficient number of poppet valves designed to take large quantities of air into the line automatically; some very serious damage has taken place due to the absence or insufficient size of these automatic poppet valves.

A vacuum is sometimes caused in a pipe line for another reason. Let us suppose a large wood or steel pipe line extends from a distributing reservoir down the hillside to a flat 200 feet below, and that the pipe line is full of water but not flowing. Now, if between the base of the hill and the distributing reservoir, a valve be shut, the pressure at the downstream side of the valve will at once drop to almost a complete vacuum, because this part of the pipe line is relieved of the atmosphere pressure, acting on the distributing reservoir. Under these conditions collapse of the pipe is likely to take place.

In connection with this subject, it may be well to call attention to the best method of filling a gravity piping system that has been emptied for any reason. The writer has heard many experienced water works men advocate filling the pipe line by sections. This is a very bad practice. The best method is to open air valves at all the summits and open the blow-off valves in all the hollows and a sufficient number of hydrants in the town. Then the valve at the impounding reservoir is opened a sufficient amount to fill the line in a predetermined time. As soon as the water appears at the first blow-off and flows full, this is shut, and as soon as it flows full at the second blow-off, that is also shut, and so on until the water appears at the city hydrants, shutting the low ones first and following them up until the high ones are shut; finally, the air valves on the line are closed and the line is in service, and no danger of water hammer has been experienced, and the line is filled in a shorter time than can be done by any other method.

Water Pipes Distributed by Tractor

Within the past two years the city of Detroit has laid a large amount of water-mains from 8 inches in diameter upward in outlying districts, many of them where the ground was low and wet and the street unpaved, making hauling very difficult in wet weather.

Under these conditions, the pipe is hauled as far as possible on trucks, then unloaded, piled in bundles, and dragged to the required locality and distributed by a Holt caterpillar tractor with a two-man crew. The same tractor has also been frequently of service in hauling truck loads of pipe out of bad sections of road where they had become stalled.

TRACTOR HAULING WATER PIPES WHERE ROADS ARE TOO BAD FOR TRUCKS TO DELIVER HEAVY LOADS

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Trade Unionism in Engineering

Trade unionism as now practiced, and engineering conducted according to the ethics of the profession, cannot mix, and certain societies would seem to be justified in the stand which they have taken or are contemplating of refusing membership to those who are members of a trade union.

The Building Trades Council of Newark, N. J., last month made a demand that all plans for buildings and structures constructed in that city must be prepared by members of the "Engineers', Architects' and Draftsmen's Union." this to take effect November 1st, after which date union labor in that city would do no work on new buildings or structures not so planned.

Such action appears to be almost absurd in its presumption, and yet appears to have been taken seriously by the trades council. It is stated that there are practically no draftemen in the architects' offices of Newark who have joined or are favorable to joining this union. How many will be frightened into joining it by this action remains to be seen, but it is to be hoped that the result will be exactly contrary to such expectations, and that any engineer or achitect who is now a member of such union will immediately resign therefrom as a protest against such action.

The American Association of Engineers has sometimes been referred to (against its protest) as an engineers' union, but its stand on such action as this is indicated by the resolution adopted by it on May 11th, "that the advocacy by any member of the A.A.E. of strikes or other questionable methods commonly employed by labor unions to secure their ends shall be considered a sufficient ground for his expulsion." This was not a statement of a new policy, for during the previous year the directors and past officers made a statement defining the position of the society, certain clauses of which are as follows:

Production should be increased—not limited. The profession cannot support strikes or lockouts or any other methods that may benefit any class at the expense of the nation as a whole.

The engineer, as an educated professional man, believes in basing his claims for proper and just reward for his services upon the justice of the facts presented, upon enlightenment of public opinion, upon loyalty between employer and employee, and upon the underlying fundamental desire of the great majority to do what is fair and right when the merits of the case in question are clearly presented and demonstrated. We believe in organized representation for the correction of wrong, the advancement of the profession and service to the public, but are opposed to methods inconsistent with the dignity of the profession and which would lessen public confidence.

The A. A. E., recognizing the many fundamental differences between the principles and objectives of the trade union and of an organization of professional men, expresses the opinion that an engineer cannot subscribe to the tenets of both.

The engineering profession will indeed be in a sad way, and the public works of this country in an even sadder one, when the choice of an engineer for designing such works, even the most important ones, is based not upon the experience, technical knowledge, wisdom and skill of the engineer but upon whether he is a member of a union. It does not seem to us conceivable that the leading engineers would ever be driven to union membership by any such action as that of the Newark Building Trades Council.. And it does not seem possible that the officials in the city government would dare to spend the hundreds of thousands yearly devoted to the construction of such works if they must rely for their designing and supervision upon such so-called architects and engineers as may have possessed themselves of union cards.

It may have been that some of the younger members of these professions have joined the union because they fear that they cannot otherwise receive due consideration of their claims. However true this may have been in the past, it is so no longer. The American Association of Engineers has proved its ability to serve these young men fully as effectively as a union and without violating ethics of the engineering profession; while numerous other

engineering societies, such as the American Society for Municipal Improvements (reference to its recent action is made in this issue) and the Brooklyn Engineers Club, have instituted practical efforts to welcome, encourage and benefit the younger members of the profession.

We hope that every engineer and architect, young or old, will protest against any such effort to unionize the profession a that here related by refusing to in any way recognize any such absurd and insolent demands upon the profession by any union or organization adopting union methods.

A Loyal Engineer Corps

Sonoma County, California, is to be envied and congratulated on the character of its engineer corps and on their sturdy integrity in refusing to participate in or submit to political interference with their public duties. When the county engineer was defeated by political opposition, the entire staff of 41 men resigned as a unit and in a formal protest expressed complete confidence in the engineer and refused to work under a policy opposed to him and inimical to public welfare.

This action demonstrates the character of the men who had the courage of their convictions even to the point of refusing salaried positions which are difficult to replace quickly and is convincing proof of the ability and integrity of their chief who has been able to collect such a staff and imbue them with high ideals and practical patriotism.

Their action, directed in opposition to their own immediate welfare, for the benefit of the county and fair dealing is the strongest possible rebuke for political meddling in technical matters. If the people of Sonoma county do not recognize this and take measures to immediately reinstate their engineer and his faithful staff, they deserve the poor work and extra cost that they may be assured will follow the displacement of such men, and the men themselves will not lack recognition and appreciation from the engineering profession and from broad minded officials who will learn of this action and will doubtless hasten to secure such unusually dependable men for their service on appreciative terms.

There are many such men with high ideals in all ranks of the engineering profession and such loyal action would oftener be noticed if the chief engineers themselves, after arriving by a long and laborious progress at their positions of responsibility, would always have the courage to resign or vigourously combat the evils and injustices that politicians and grafters often try to impose on them. Some would doubtless lose their positions at first, but the public would soon uphold them when conditions were fully explained and men of militant integrity would find themselves at a premium for many private and corporate positions.

Staff Resigns on Chief's Defeat

Lloyd Aldrich, county engineer of Sonoma county, Cal., was defeated at the election on August 31, owing to the attitude of public officials and politicians and the lack of support of the people of the county.

The engineer's staff, numbering 41 engineers, has resigned in a body as a protest against the treatment accorded to Mr. Aldrich, giving out the following reason:

Resolved, That we, the engineering organization of Lloyd Aldrich, county engineer of Sonoma county, do hereby express our great confidence in the ability and integrity of our chief, and our refusal to subordinate ourselves to authority governed by ideas which we believe are not in accord with the public welfare and the best engineering practice, by making our resignation from the service of Sonoma county coincident with his own.

Atlantic City Garbage Disposal

Following the refusal of the previous contractor for garbage collecting and disposing of Atlantic City's garbage to carry out his contract, the city commissioners recently asked for bids for performing this work for one, three and five years. Only one bid was submitted on October 28 and this was tendered by a newly organized company which proposed to use the plant constructed by the Farmers' Product and Supply Company which had formerly held the contract. The latter company's contract was for $195,000 for five years, while the bid recently submitted was for $190,000 for one year, $495,000 for three years or $750,000 for five years. The city is now paying at the rate of $123,000 a year for the collection of the garbage until a regular contract can be entered into.

The company which bid, the Island Fertilizer Company, claimed that it had lost $190,000 during the two years and seven months that it had operated under the old contract, and that prices had advanced so that its loss would have been at least $400,000 had it carried out its contract to the end of its term; coal, for instance, costing nearly four times as much now as then and being used at the plant at the rate of 4,000 tons a year. On the other hand, a year ago the company was getting 11 cents a pound for grease and to-day was receiving but 6 cents, this drop being attributed to the importing of great quantities of vegetable oils from Japan and the south.

Action on the bid was postponed to November 11. Several of the commissioners considered the bid entirely too high, and there was some consideration of municipal ownership of a plant.

Construction Hearings

The Senate Committee on Reconstruction and Production known as the Calder Committee, has just left New York for a trip through the Central West and South during November.

Hearings will be held at Kansas City, November 17; St. Louis, 18; New Orleans, 20; Birmingham, 22; New York City, 24th.

The following contractors have been asked to testify on existing conditions from the standpoint of the general contractor, offering constructive criticism for remedying conditions which should be changed: James R. Gloyd, Cleveland; W. A. Rogers, Chicago; Fred R. Weitz, Des Moines; Edward Peterson, Omaha; A. C. Everham, Kansas City; A. P. Greensfelder, St. Louis; G. E. Reimann, New Orleans, and P. E. Bostick, Birmingham.

The A.S.M.I. St. Louis Convention

Synopses of the President's address and the papers and discussions on sewerage and sewage treatment, including the latest information covering activated sludge plants and tests; also papers of pavements and paving materials.

The key-note of the Convention was expressed by the President in his annual address. It emphasized the desirability of carrying the society into larger usefulness and of bringing the younger men in, as workers and thus transmitting to them the enthusiasm and the constant interest in the Society which has been and is so strong a characteristic of the older men. Several of those who joined the Society before 1900 are still active in its work, regular attendants of the Conventions, regular contributors to its programs and participators in its committee work.

The appointment of new men to responsible positions on committees, their election to office, their participation in the presentation of papers and discussions, all show the application of the same principle.

There is now an evident desire to increase the membership of the society so that its benefits can be more generally distributed and the only thing which may retard its growth is the apparent necessity, at least for a time, of increasing the dues to meet the present high cost of printing.

The relative interest in the subjects discussed at conventions is shown in part by the responses to requests for preferences as to committee assignments. Sewerage, street paving, city planning, water works, were, in order, those having the greater number of votes. For the specification committees, asphalt, brick, bituminous concrete, had the greater number of preferences expressed, the votes for the other positions being quite evenly divided, except that broken stone roads and wood block had no votes.

The following review of the program is taken up in the order of this preference of the members as expressed to the President.

SEWERAGE AND SEWAGE TREATMENT

The program on sewerage and sanitation was very comprehensive, extending from the history of the St. Louis sewer system, extending over 70 years, to a report in the discussions of the beginning of operation of the new sludge-drying apparatus at Milwaukee on Monday of convention week.

W. W. Horner's brief paper on the St. Louis sewer system was so thoroughly organized that it gives a very clear idea of the advances in the science of sewerage in the past 70 years and the application thereof to St. Louis problems. It was supplemented by a number of lantern slides showing views of some of the special designs and structures necessary in the solution of these problems, which were explained by Mr. Horner for Guy Brown, the engineer in charge of sewer construction.

Most of the papers were devoted to sewage disposal. Mr. Gascoigne's paper on grit chambers was read by title as neither author nor paper appeared in time for the program.

Professor Edward Bartow's paper on the present status of the activated sludge process reviewed the work which has been done recently. It was illustrated by views of the Houson, Texas, plants, the largest in successful operation in the world and of some English plants, in particular, that at Manchester, the largest foreign plant. The paper was given up principally to the experimental plant in process of installation at Urbana, Ill., by the State Water Survey Division, the plans for which were made by Dr. Bartow, and part of the installation. This plant is now in charge of the new director of the Survey, Mr. Buswell, since Dr. Bartow has transferred his field of activities to the Chemistry Department at Iowa State University.

This Urbana plant will have a capacity of 100,000 gallons of sewage a day and will be equipped for screening, aeration, sludge-drying. The illustrations showed the grit chamber, the Dorr screens and sludge concentration tanks whereby the amount of air necessary in the activated sludge process as greatly reduced. Intermittent aeration will also be tested, according to English systems. Various systems of sludge-drying are to be installed and tested.

Dr. Bartow mentioned also the plant at Argo, Ill., at a large corn products plant, where straight aeration and the Dorr system will be tested side by side.

The Argo plant and that for the Chicago stock yards were described somewhat more in detail by Langdon Pearse in his paper on the work of the Chicago Sanitary District as well as a rather successful application of refuse treatment to tannery wastes on the North Branch of the Chicago river, which will probably be applied to the wastes from the other tanneries of that district. Mr. Pearse also gave a very interesting, though brief, history of the entire work done by the Sanitary District and showed the necessary extensions of this work which must be made into the fields of sewage treatment and regulation of stream flow. The general features of the proposed regulation of the flow of the Niagara and Detroit rivers were noted and it was demonstrated that both stream regulation for increase in dilution in the drainage canal and sewage treatment must be resorted to in order to keep the Des Plaines and Illinois rivers in sanitary condition as the population tributary to them increases.

The improvements in the northern part of the Drainage District were shown in some detail, being some of the later work of the commission.

In the discussion Mr. Pearse referred to the estimates made recently for Bloomington, Ill., showing comparative costs of various sewage disposal systems for an estimated future population of 50,000—sprinkling filters, $630,000, activated sludge, $540,000. But, exclusive of interest, the sprinkling filters will cost $21,000 a year to operate while activated sludge will cost $81,000, credits on which might bring it down to $56,000. The use of the Dorr process might reduce the cost to $51,000. In all these estimates electricity is counted as 2 cents per k.w. hr. Total lack of area on which to dispose of sludge in both Chicago and Milwaukee, makes the choice of the more expensive process imperative. The improvements of the future must be made mainly in the way of reduction in cost of operation.

T. C. Hatton reported that the activated sludge produced at Milwaukee had from 2 to 4½ times the manurial value of sludge from the sprinkling filter plants, whether septic or Imhoff or other preliminary tank treatment, or from 4 to 7 units of ammonia, with value of about $6 a unit. This accounts for the credits given the activated sludge process in the Bloomington estimates. He reported the total cost of operation of the activated sludge process as $35 per million gallons, the credits for value of sludge as $18 and the net cost of operation of the activated sludge process at $17 per million gallons of sewage. His best information is that sprinkling filters on the same basis cost about $15 per million gallons to operate. Electric current in Milwaukee is charged at 1 cent per k.w. hr. and may at times cost less.

Sludge-drying tested in Milwaukee was a failure. Within the past six months the drying of sludge by pressing in two types of presses and four types of plates has been made very satisfactory. Eight per cent of moisture is reached within 1½ hours. However, the character of the sludge changes so decidedly in cold weather that the time required to come down to 8 per cent moisture is increased to 5 or even 7 hours. Chemists report that control of the character of the sludge is possible and experiments are to be made in this line to produce a uniform product if possible. Colloidal chemistry is to be called into use in these tests.

J. C. McVea, city engineer of Houston, reported on their two plants, one of 6,000,000 gallons capacity per day (now handling a little more) and one of 2,000,000 gallons capacity, now handling about 1,000,000 gallons. The electricty rate is 1 cent per k.w. hr. The clear effluent is sufficiently pure and aerated to support fish life even when left by a stream overflow in the settling basin and effluent channel. The sludge is sticky and difficult to convey to the heating tubs where moisture is reduced to 10 per cent.

An operating chart for last December which was shown on the screen showed 96 to 98 per cent reduction in suspended solids, 6 to 6.4 million gallows flow of sewage per day, which is all by-passed while diluted sufficiently by a rainstorm although the operation of the plant is continued to preserve the operation on the sludge. The percentage of sludge in the reaeration channels, based on 30-minute observations, averages 35 per cent, with 30 to 36 as limits. Relative stability, after 10 days incubation at 37 deg. C., is about 98 per cent, on one day falling to 86 per cent. Reduction in oxygen varies greatly between 50 and 84 per cent, averaging 65 to 70.

Nitrates run 40 to 50 parts per million, free ammonia in raw sewage runs as low as 10, averaging 15 to 18, and in the effluent runs fairly uniform at 5 parts per million. Air used is 1.44 cu. ft. per gallon of sewage treated, distributed to the sewage lift .06, to the main aeration tank 0.94, and to the re-aeration channel 0.44 cut. ft. per gallon. The average time in the aeration tank is 2¼ hours; average time of re-aeration 4 hr. 40 min., or a total time in the plant of 6 hr. 55 min. Operating cost of the plant, not including any overhead, is about $14 per million gallons handled in December. The sludge is not treated.

A paper on sewage treatment at Bridgeport, Conn., using Riensch-Wurl screens, was not received in time to present at the convention.

Trade-waste disposal and treatment was discussed by E. S. Dorr, of Boston, who gave the favorable results of an experiment on a small scale of the application of the Miles acid process to tannery waste, and by R. S. Weston, who defined the character of trade wastes and gave examples of results of treatments of each of them. (The former paper we have already printed; the latter will be given soon.)

A paper by W. D. Bee on the experience of the Columbus, Ohio, garbage reduction plant during the first ten years was read by title. (This was published in the November 6th issue of PUBLIC WORKS.)

SNOW REMOVAL

H. S. Richards presented an interesting paper on snow removal by the Chicago South Park Commission with motor plows, horse plows, or shovels and wagons, according to the necessities of the case. This is a very important subject since automobiles and trucks must have streets and roads as clear in the winter as in the summer.

The principal point of the paper is the necessity of having an organization which can be called upon at any time of day or night to get to work promptly and remove the snow as it falls, since snow which has become packed by travel is a very different problem from the fresh snow and demands greatly different apparatus and methods and requires much more time, labor and cost.

The details in the paper show the organization in Chicago, the various apparatus used by it and the methods of procedure. While possibly not exactly applicable to other conditions, the paper and the system deserve the closest study. Since the conditions in the park and boulevard system cover practically all those met on city streets of all sorts and in some cases closely approximate thoseof country roads, any engineer having the snow removal problem on his hands will find something of direct interest to him in Mr. Richard's paper.

PAVEMENTS AND PAVING MATERIAL

The presentation of papers on paving subjects showed in general the same preferences as those

shown in the expressions of members regarding assignments to committees.

More papers were devoted to asphalt than to any other paving material, beginning with Herbert Spencer's paper on asphalt production, refining and related problems, illustrated by lantern slides which showed the methods of obtaining asphaltic materials, refining them to produce the desired grades for paving purposes, transporting the asphaltic oils and the refined asphalt, storing the asphalt in cars or tanks at or near the work, in steel and concrete tanks, and transporting it to points of use.

R. R. Barrett's paper on the elimination of unnecessary tests from asphalt-cement specifications was also devoted to the materials and showed the necesity, from the standpoints of convenience and economy, of reducing the variations in the specifications for asphalts for the same use which are met with in common practice. That these variations are unnecessary from the standpoint of quality and efficiency is demonstrated by the fact that this society and the U. S. Bureau of Public Roads have reduced such variations in specifications to a minimum consistent with full definition of the grade and quality of material required for a certain use. The numerous varieties of tests devised by chemists and engineers working independently have been collected and revised by experts familiar with all conditions and with the tests necessary to insure that the proper materials are secured and have been standardized so that, if followed, they will obtain the desired results and with a uniformity not possible under the former lack of system. The effort expended in devising original tests, if exerted in extending the use of the standard tests, would soon reduce this complication and irregularity in value of the resulting pavements.

The basic characteristics of a good asphalt-cement are proper consistency, cementitions property and stability. Other important properties are purity, homogeneity, resiliency and uniformity. These are all determined by means of tests of solubility in carbon disulphide for bitumen content; flash point to detect presence of too light oils; meltiug point and viscosity to give data as to ease of handling and presence of blown asphalt of low ductility; penetration, to determine hardness or consistency, with limits at 77 degrees for each class of pavement desired and at 32 and 115 degree for susceptibility to temperature changes; loss on evaporation as an accelerated exposure test; penetration after evaporation to show effect of heating in making paving mixture and indication of changes with age at weather temperatures; specific gravity as gage of uniformity and to determine shipping weights; ductility for judgment as to cohesion and brittleness, too high ductility indicating reduction in resiliency and too low ductility lack of cementitionsness and sometimes to indicate certain brands of material.

Other tests not usually necessary if the above are in use are per cent of paraffine scale and of sulphur, solubility in ethyl alcohol and fixed carbon.

The use of the specifications of this society should be extended, as they are concise, contain only the essential tests which insure a high grade of asphalt cement, do not exclude any good asphalts, have no superfluous clauses and therefore should be recognized as the standard of the country and all societies working on this subject.

Julius Adler's paper on the present status of macadam base for bituminous pavements and George Warren's discussion of the subject are given in this issue of PUBLIC WORKS.

John B. Hittell presented a valuable paper descriptive in detail of the methods of construction of asphalt pavement north of Chicago, including drainage and foundation and also gives several traffic counts. It will be good material for the study of the relations of traffic and pavement design and construction. (This paper we published last week.)

Brick pavements were well covered as to present standard methods of construction by J. C. Travilla's excellent paper on paving brick and brick pavements. S. Cameron Corson's paper gave some local history tending to show the advantage of small over block size of bricks for street paving

Although no one seemed to have much interest in wood block pavements, the most earnest discussion was of Hermann von Schrenk's paper on recent experience with wood block pavements.

Stating that many failures of wood block pavements have occurred in the past two years, he attributes them to conditions entirely under the control of the engineer.

He believes that where the present A. S. M. I. specifications for timber are followed few if any failures will occur because of the character of wood used. Tests show that sap wood is as strong as heart wood and that in Douglas fir the weakest wood is in the center of the heart. Failure of sap wood is therefor attributed to nature of treatment rather than quality of the wood.

Preservatives were not always according to specifications but there was but little trouble, the exact quality of preservative being of relatively less importance.

Treatment methods have proven satisfactory in every way and are not responsible for recent failures.

The condition of timber is specified as air-seasoned or green, to be treated within three months of time of paving. Recent experiences seem to indicate that a minimum moisture content should be specified, which would require thorough air-seasoning. Penetration throughout the sap-wood is obtainable only if the blocks are as dry as possible. Steam treatment is not so much to drive out water as to drive out air, which is the principal cause of bleeding, but will not produce equable distribution of creosote oil in a wet piece of wood. Air drying is therefore necessary.

Rigid following of the specification for inspecton is recommended as it is the only one producing results.

The failures of wood block pavements are almost entirely due to the manner of laying them. Unequal swelling of blocks from absorption of water through sand cushions causes bulging.

The failures of pavements and the rotting of blocks due to lack of penetration of sap-wood by the creosote oil, the blocks being comparatively green, was shown by a number of lantern slides and gave rise to a considerable discussion and the members objected to the change of specifications until more experience has been secured.

Construction Questions Answered

Suggestions as to methods, "wrinkles" and appliances that may be used to overcome difficulties arising in construction work. We invite questions concerning such problems that may arise from time to time in the experience of any of our readers. Answers prepared by competent authorities will be published promptly. It is hoped that others who have solved similar problems differently will send us their solutions for publication also; or describe new "wrinkles." If it is only a new way to drive a nail ,it may help some one.

Protecting Concrete from Frost

All specifications for concrete construction contain, or should contain, clauses governing such work executed during frosty weather. Sometimes they restrict the work by prohibiting it where the temperature is below 28 or 30 degrees Fahrenheit; sometimes they say it must be safeguarded satisfactorily to the engineer; and sometimes explicit directions are given for the manner in which the work must be carried on in cold weather.

OFFICIAL REGULATION

Where the work is entirely prohibited it might often be allowed if the owner and engineer were confident that that kind of concrete work had been done satisfactorily in very cold weather and that the contractor was able, competent and willing to use methods that will insure such success.

Where it is provided that the concreting shall be done to the satisfaction of the engineer, it is greatly to the contractor's interest to know exactly what is required and what will be accepted, what is optional, and just how the work can be most advantageously perfected.

Even when the methods of concreting are specified in the contract it is possible that the clauses are inadequate, too severe, designed for other conditions, not well adapted to the specific work, or that various points in them could be modified to the contractor's advantage without detriment to the work.

In all of these cases the contractor should be thoroughly informed as to why and when the concrete needs protection, how it can be most efficiently and economically protected, and what methods and appliances have been found most satisfactory by those most experienced in this matter. Such knowledge will enable him to plan his work most advantageously, to anticipate the requirements in making his estimate and in providing his equipment. It will also put him in position to request modifications of unsatisfactory features of the contract and often to suggest changes that will be acceptable to the reasonable engineer and architect, that will benefit the construction and be advantageous to himself. Such information is given in this article and has been prepared from data furnished by concrete experts and by successful high-class contractors who are specialists in concrete construction and have developed efficient and economical methods of handling it in cold weather.

Many contracts for buildings, foundations, piers, arches, tunnels, bridges, highway pavements and other kinds of outdoor work are now in progress but are not likely to be completed before freezing weather sets in, although some of them could be completed within a comparatively short time thereafter if progress is uninterrupted. If the work is left unfinished, to be resumed next spring, it is likely to be subject to some risk or deterioration due to its prolonged incomplete condition, and a large expense is certain to be involved in overhead charges, delayed payments, the removal and storage of plant, the injury to materials, the disorganization of the force, and the lost time of stopping and beginning again, all of which might be saved and interruptions to other work avoided if the work can be carried on to completion without intermission.

Some work may include a minor quantity of concrete, the placing of which governs other parts of the work that might be carried on very advantageously during the winter if the concreting were permitted. Even where the concrete is the major part of the construction, it may frequently be possible to secure much better, cheaper and more reliable transportation and labor during the winter months than before or after. The early completion of the construction is almost always of importance and the saving of several weeks or months by continuing the work during the winter and the putting of the structure into service so much sooner is often of high money value. It is therefore evident that safe methods for winter concreting are likely to be of value and importance to a great many contractors and may even enable them to handle work that they could not otherwise undertake, to keep their organization active continuously all the year round, and to save considerable expense from starting and stopping. These considerations apply to public and private buildings of all sorts, to foundations, piers, bridges, highways, sewers, and, in fact, to almost all kinds of construction that the general contractor undertakes.

In Canada, where very severe cold is encountered, out of 38 cities replying to a questionnaire, 21 stated that they have built sewers during the winter. In the city of Galt, winter sewer construction has been practiced since 1913, when it

was commenced for the sake of giving employment to the idle. In St. Johns, N. B., such work is done partly for the sake of maintaining a permanent organized gang ready for emergency work.

From the different replies it is estimated that the increased cost of sewer construction in winter varies from 25 to 100 per cent, although in some cases the excess may be eliminated by the greater abundance of labor, lower wages and the probability that the men will be compelled to work harder to keep warm, although the greatest advantage is thought to be maintenance of organization and the continuity of work that distributes overhead charges throughout the entire year.

EFFECT OF FROST ON FRESH CONCRETE

Official tests to destruction on specimens of 1:2:4 gravel concrete show that when maintained the first 5 days at a temperature of 60 degrees it will develop the normal compressive strength of about 970 pounds per square inch. When seasoned for 5 days at a temperature of 60 degrees and then for 14 days at a temperature below freezing the average strength was only 1,042 pounds, showing a gain of only 125 pounds in two weeks, an increase much less than normal. When the specimens were seasoned 5 days at 60 degrees, and 28 days at a temperature below freezing they developed an average strength of 1,063, showing an increase of only 146 pounds in the four weeks of cold seasoning. The same specimens seasoned for the entire 33 days at a temperature of 60 degrees would normally develop a strength of about 2,000 pounds per square inch, very nearly double the actual strength.

Of course, if concrete is frozen immediately after being placed it entirely loses the advantage of the 5 days' warm seasoning above mentioned, and the strength will be reduced far below that of the above specimens and may indeed be almost nothing and the concrete be virtually destroyed.

These tests entirely discredit the common belief that if concrete sets for 5 days at a temperature of 60 degrees it will afterwards continue to gain strength at a normal rate in a low temperature. Even if it is not actually frozen, the gain in strength will be exceedingly small and slow when the temperature is low.

Other specimens were seasoned for three months at a temperature below freezing and then for 7 days at a temperature of 70 degrees, and when tested some of them showed no appreciable compressive strength. Others were stored for seasoning 4 weeks at a temperature of 70 degrees and developed an average strength of about 700 pounds per square inch, against 2,000 pounds for similar concrete under normal conditions.

This shows that when concrete is frozen and thawed it develops strength very slowly, and that for safe construction the concrete must not only be kept from freezing at first but must be kept warm for at least 4 or 5 days before exposing to the cold, which immediately checks farther gains of strength. It is vital that wet concrete should be prevented from freezing, and it is almost equally important that it should be maintained at a temperature of 60 degrees or more for several days after it has been placed and until it has developed a large fraction of its ultimate strength.

ESSENTIAL REQUIREMENTS

The special requirements for cold weather concreting are that none of the ingredients should be at a low temperature when mixed, that freezing be absolutely prevented, that a comparatively high temperature be maintained for several days after it has been placed, that it be protected from severe cold as long as possible after placing, and that it be temporarily supported if it becomes necessary to subject it to heavy loads soon after placing in cold weather.

To accomplish this, the aggregate and the water should be thoroughly warmed in frostly weather; the cement, being of much smaller volume and necessarily kept dry, does not need special treatment.

The water may be artificially dosed so as to lower its freezing point several degrees and thus prevent accidental injury to the concrete when the temperature is temporarily or unexpectedly so low as to greatly retard the setting.

If the weather is continuously cold or falls below the freezing point at any time, the placed concrete should be artificially warmed and protected.

If it is necessary to strip the forms soon after concrete has been placed in cold weather, it may be necessary to shore or otherwise support beams, girders and slabs until they have slowly developed additional strength.

The chemical reactions involved in the setting of the cement develop a considerable amount of heat that, under favorable circumstances, may be sufficient to prevent freezing when the temperature is only a few degrees below freezing. This, however, is not the case in small masses of concrete or when it is spread in very thin layers or exposed to severe wind, and at best is only temporary, while the setting process is going on, and therefore only prevents injury to the final strength of the concrete but still permits great retardation of its normal development of strength.

Substantially the same is true with regard to any treatment of the mixing water that will lower the freezing point. It is only a makeshift which is valuable to prevent injury from sudden unexpected frost and in nowise increases the strength or hastens the setting of the concrete. On the contrary, some solutions intended to prevent freezing have a distinctly injurious effect on the ultimate strength or properties of the concrete and retard the setting. The only proper way is therefore to have the mixed concrete and the forms at a temperature of 60 degrees or higher when the concrete is placed and to maintain this temperature for several days afterwards. This can be efficiently accomplished in various ways suitable to different conditions and to the character of the construction.

SIMPLE MEASURES OF PROTECTION

For concrete placed under water there is no difficulty of any sort if it is at a temperature above freezing when deposited, because it is impossible for the concrete to freeze while the water is liquid around it and, although it will set slowly in very cold water it is an advantage to be submerged in any case. Concrete can therefore always be safely deposited in foundation pits, sewer trenches, and other excavations even in the coldest weather, if they can be immediately filled with water that remains unfrozen above the top of the concrete although ice should form on the surface of the water.

If the trenches or other excavations are dry, the heat of the earth is likely to be sufficient to prevent freezing at a depth of over 6 to 10 feet below the surface, provided the concrete is protected on the top from the atmosphere.

Large masses of concrete, such as bridge piers, heavy walls and the like, have a much smaller proportionate exposed surface than small masses, and the chemical heat developed in them may suffice in moderate cold, if the outer surface of the concrete is protected by any adequate covering, preferably an insulating one. In very cold weather such construction may need additional protection in the way of jackets enclosing the forms and protecting them with sawdust or other insulating material, a layer of warm air, or a mass of manure, the decay or fermentation of which will develop considerable heat. In the latter case, however, care must be taken to prevent contact of the manure with the surface of the concrete, which would be discolored. This may be provided for by interposing tar paper, building paper, felt or some other material to separate them.

For light and exposed concrete work, especially such as beams, girders, or slabs, walls, columns, or other structural work, it will generally be necessary to completely enclose the fresh concrete in forms by some kind of a temporary construction that will retain the air surrounding the concrete which should be heated to about 70 degrees and maintained at that temperature for several days. Such provisions are often necessary in building reinforced concrete factories, filter structures and others, and have been developed to a satisfactory degree of efficiency and economy by contractors who have large experience in this sort of work.

By taking such precautions they are able generally to carry on uninterrupted concrete construction and even to begin it in very cold weather at an additional expense of only 5 or 6 per cent of the total cost of the concrete construction in warm weather.

The same considerations apply to the construction of bridges, arch spans, culverts and the like.

Generally the construction of concrete highways and pavements and the bases or foundations for other hard-surface pavement, is not permitted during long-continued cold weather but must be safeguarded for short periods of cold weather or for unexpected frost, and the precautions taken in these cases might sometimes be amplified and modified to permit the construction to be carried on continuously during cold weather if the temperature did not fall too far below freezing. For such work the essentials are to have the aggregate dry and hot, the mixing water warm, to put the concrete in place rapidly on sub-grade which has no traces of frost in it, and then to protect it thoroughly from freezing as soon as it is placed.

The sub-grade may be thawed by open fires or hot blast machines and kept protected until it receives the last course of concrete and is covered and artificially warmed if necessary to prevent freezing and facilitate setting. Movable paper or canvas roofs enclosing an air chamber a few inches over the concrete can be set on the pavement immediately after the concrete surface is finished, and the air can be warmed by steam pipes or properly arranged coal or coke fires maintained as long as necessary; and after the concrete has sufficiently set, if the temperature is not too low, the fires and the covers can be replaced by a thick covering of hay, dry earth or manure maintained as long as the engineer shall direct. The aggregate can usually be heated by wood fires in improvised furnaces buried in the material or by steam pipes, and the mixing water can be heated in kettles or by steam.

Labor Notes

In an open letter to the Board of Commerce the mayor of Detroit urges all employers of labor to ration all work wherever possible in order to keep in Detroit the great body of skilled workmen who are now unemployed. From figures given by the secretary of the Employers' Association it is estimated that 60,000 men are now out of work in Detroit.

The New York State Public Employment Bureau in Brooklyn reports a decrease in the requests from employers for workmen during the last few weeks. Some large industrial establishments there have been laying off workers on account of cancellation of orders or general slackness of business. Chauffeurs, machinists and mechanics are seeking employment. In four weeks in September 469 applicants were placed and in three weeks in October 417. Employers seeking help are offering 20 per cent less than last spring, and an increase in the number of unemployed is reported from Chicago where there is also an influx of workmen that have been laid off in Detroit, in Akron and other cities where the rubber and tire industries have been reduced.

Labor Unions Threaten Engineers

The Building Trades Council of Newark, N. J., has addressed an open letter published in the Newark Call, to engineers and architects, stating that after November 1 plans will not be accepted by the council that do not bear the stamp of the Engineers', Architects' and Draftsmen's Union.

Recent Legal Decisions

SIGNPOSTS AT INTERSECTION OF STREETS NOT DEFECTS —CARE IN MAINTENANCE

In an action for injury to an automobile caused by collision with an overturned "silent policeman," consisting of a heavy circular base and an upright post, surmounted by a sign and a suitable light, the Connecticut Supreme Court of Errors holds, Aaronson v. City of New Haven, 110 Atl. 872, that to make the city liable there must be a defective highway. When in the course of events leading up to the injury to the plaintiff's automobile did this highway became defective? Not by the mere installation of a silent policeman at the intersection of two highways for the purpose of directing traffic and of requiring travelers to obey Section 26 of Public Acts, 1919, c. 233. It could not be said that a sufficiently conspicuous guidepost for traffic placed at the intersection of two streets makes the highway defective. The court took judicial notice of the common use of such devices at such locations and that they do serve a useful purpose in directing traffic and promoting obedience to the law. The fact that such a guidepost is liable to be displaced and to become an obstruction to travel is relevant only as it imposes on the defendant city a commensurate degree of diligence in inspecting the device, or in removing it after it is displaced.

There was evidence from which the jury might have found that the post was knocked down and rolled into the street an hour prior to the automobile striking it, and that the police station was within 12 minutes' walk, and had been notified half an hour previous to the accident. It was therefore held that the jury might properly have found that the city had not acted with reasonable diligence in removing it after notice, and a motion for a new trial on the ground that a verdict for the plaintiff was against the evidence, was held properly refused.

COURT'S DISCRETION AS TO INJUNCTION AGAINST HIGHWAY EXPENDITURE

The South Carolina Supreme Court holds, Wilson v. Cureton, 103 S. E. 789, that in a suit for injunction by taxpayers and citizens to restrain an alleged illegal expenditure of public moneys on highways by the highway commission, the presiding judge has a discretion in granting the injunction. The court thinks it is not wise or prudent to allow public officers to incur large liabilities based upon an honest misconstruction of a statute, and then to tie their hands and stop the work by an injunction. It is also held that in the South Carolina statute of March 1, 1917, directing the employment by the highway commission of a road engineer, and prescribing his duty to survey, locate and relocate, when necessary, every section of road before permanent work shall be done on it, the words "when necessary" refer to "relocate," and not to the whole statute.

"PUBLIC WORKS" DOES NOT INCLUDE PRIVATE REFUSE DISPOSAL PLANT

In an action by the United States for the benefit of a materialman against a contractor with the District of Columbia for the collection and disposal of refuse at a plant to be provded by the contractor and against the surety on his bond, the Court of Appeals of the District of Columbia holds, United States v. Faircloth, 265 Fed. 963, that the Act of Feb. 28, 1899, requiring persons contracting with the District for public buildings or public works to give a bond to secure payment for labor and materials, has no application to the construction of such a plant where it does not appear that the District has any interest in the building or the property on which it is erected.

MUNICIPALITIES' POWER RESPECTING REGULATION OF BUSINESS AND HEIGHTS OF BUILDINGS

In an action by a vendor against a vendee for specific performances of a contract for the purchase and sale of real estate in the city of New York, the question was whether the New York "Zoning" resolution of July 25, 1916, constituted an incumbrance which would relieve the purchaser from its obligation to complete the purchase, as provided by the contract. The resolution divides the real estate into three districts, "residence district," "business district," and "unrestricted district," and regulates the size and height of buildings and the locations of trades and industries. The New York Court of Appeals holds, Lincoln Trust Co. v. Williams Bldg. Corp., 128 N. E. 209, that the resolution is a proper exercise of the police power and did not constitute an incumbrance. The exercise of such power, within constitutional limitations, depends largely upon the discretion and good judgment of the municipal authorities, with which the courts are reluctant to interfere. The conduct of an individual and the use of his property may be regulated, Village of Carthage v. Frederick, 122 N. Y. 268, 25 N. E. 480. In the exercise of the police power the uses in a municipality to which property may be put have been limited and also prohibited. Thus, the manufacture of bricks; maintenance of a livery stable; a dairy; a public laundry; regulating billboards; a garage; the installation of sinks and water closets in tenement houses; the exclusion of certain businesses; a hay barn, wood yard, or laundry; a stone crusher, machine shop, or carpet beating establishment; the slaughter of animals; the disposition of garbage; registration of plumbers; regulating the height of buildings; compelling a street railway company to change the location of its tracks; prohibiting the discharge of smoke; the storing of oil; and, generally any business, as well as the height and kind of building, may be regulated by a municipality under power conferred upon it by the legislature.

NEWS OF THE SOCIETIES

Nov. 15-17—CITY MANAGERS ASSOCIATION. Annual convention at Cincinnati, O. Executive Secretary, Harrison G. Otis, 812 Tribune Bldg., New York City.

Nov. 18-19—AMERICAN ENGINEERING COUNCIL. Organization meeting. Washington, D. C.

Nov. 18-19—FEDERATED AMERICAN ENGINEERING SOCIETIES. Annual meeting. New York; Washington, D. C.

Dec. 7-10—AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Annual meeting, New York. Secretary, 29 W 39th St., New York City.

Dec. 9—THE BROOKLYN ENGINEERS' CLUB. Annual Meeting, election of officers.

Dec. 13-16—AMERICAN ASSOCIATION OF STATE HIGHWAY OFFICIALS. Annual convention. Washington, D. C.

Dec. 16-17—THE KANSAS ENGINEERING SOCIETY. Annual meeting. Topeka, Kansas.

Jan. 25-27, 1921—THE AMERICAN WOOD PRESERVERS ASSOCIATION. Place of meeting to be announced later.

Jan. 25-27—ASSOCIATED GENERAL CONTRACTORS OF AMERICA. Annual convention. Washington, D. C.; New Orleans.

Feb. 7—AMERICAN ROAD BUILDERS' ASSOCIATION. Annual convention. Coliseum, Chicago. E. L. Powers, 11 Waverly Place, New York City.

AMERICAN WATERWORKS ASSOCIATION, NEW YORK SECTION

The New York Section of the American Water Works Association held its regular monthly meeting at Hotel McAlpin October 20. More than seventy members and guests were present and after luncheon was served the meeting was addressed by President William W. Brush, chief engineer of the Department of Water Supply, Gas and Electricity, New York City, and by Beekman C. Little, president of the American Water Works Association. The principal address was made by Professor George C. Whipple, of Harvard University, on eight months in Europe with the Red Cross societies, in which he gave information concerning the water supply and sanitary methods and conditions in the war zone.

DISCUSS HOUSING CONDITION AT DETROIT

Dr. Henry F. Vaughan, health commissioner of Detroit, announces that a national conference of health officers to consider housing questions will open at Detroit, Mich., on November 30.

PROFESSOR WHIPPLE ADDRESSES AMERICAN WATER WORKS ASSOCIATION

At the meeting of the New York section held in New York City on October 20, Professor George C. Whipple of Harvard University, for the past eight months chief of the Department of Sanitation of the League of the Red Cross Societies, with headquarters at Geneva, Switzerland, outlined some of his work abroad and some of the prospective work of his successor, Colonel F. F. Longley.

During his stay abroad, Professor Whipple gave special attention to sanitary surveys, water supply studies and public health education. The public water supplies in the European countries, especially in Roumania, are deplorable, in some cities there being none whatever. In Roumania and other parts of Europe (affected more than others by the war) filter plants and pumps are out of use entirely on account of the lack of small parts which cannot be obtained at any price.

There is very little public health education in Europe outside of England. "Some instruction in the subject is given in medical schools, but this is by doctors and is quite inadequate, especially along sanitary lines. Professor Whipple says that it is possible that a school of public health will be established in Switzerland, which may be a government school, or it may become international in character.

He also stated that the League of Red Cross Societies, in conjunction with the Tuberculosis Commission of the Rockefeller Foundation, is carrying on a public water supply study in France.

Colonel Longley is now engaged on a glossary of terms used in sanitation and public health.

FIFTH INDUSTRIAL SAFETY CONGRESS

Among the speakers at this congress, to be held December 6-9, under the direction of the State Industrial Commission, at Syracuse, N. Y., will be Dr. R. M. Little, director of the American Safety Institute, New York City; C. H. Thompson, safety engineer, Eastman Kodak Company, Rochester; C. L. Smith, safety engineer of the Carborundum Company, Niagara Falls.

The students of the Syracuse School of Oratory will present moving pictures, tableaux and pageants to demonstrate safe and unsafe practices.

Willard A. Marakle of Rochester is chairman of the committee on invitations and publicity and Mark A. Daly of Buffalo is chairman of the program committee.

HIGHWAY CONTRACTORS FORM ORGANIZATION

The Pennsylvania highway contractors recently held a meeting in Harrisburg and appointed a temporary committee to draft a constitution and bylaws and prepare other details for the organization which is to be known as the Associated Pennsylvania Highway Contractors. Sixty contractors were present. H. H. Wilson of Winston & Co., has been made chairman and E. J. Harding of the Associated General Contractors of America will assist in perfecting the permanent organization of the association.

LOUISIANA ENGINEERING SOCIETY

At the regular meeting of this society held Monday, November 8, Mr. John Klorer spoke on "The Proposed Separation of the Red and Atchafalaya Rivers from the Mississippi and Its Effect on Flood Heights."

YORK ENGINEERING SOCIETY

The Engineering Society of York, Pa., voted on October 18 to join the Federation, and the Washington Society of Engineers took similar action on October 20.

DETROIT ENGINEERING SOCIETY

The Detroit Engineering Society has appointed D. J. Sterrett to represent it at the meeting of the Council, and the Buffalo Engineering Society has appointed W. B. Powell.

The Florida Engineering Society has appointed L. R. McLain as its representative at the Council.

AMERICAN INSTITUTE ELECTRICAL ENGINEERING

The board of directors of the American Institute of Electrical Engineers has appointed the following members of the Institute on the American Engineering Council: Comfort A. Adams, Cambridge, Mass.; A. W. Berresford, Milwaukee, Wis.; H. W. Buck, New York; F. L. Hutchinson, New York; W. A. Layman, St. Louis, Mo.; William McClellan, Philadelphia, Pa.; L. F. Morehouse, New York; L. T. Robinson, Schenectady, N. Y.; Charles S. Ruffner, New York; L. B. Stillwell, New York; Calvert Townley, New York.

AMERICAN SOCIETY OF AGRICULTURAL ENGINEERS

The southern section of this society held a two-day meeting in Memphis, Tenn., on August 30 and 31, devoting its attention to agricultural engineering problems as they are found in the South.

Among the papers presented were "Methods of Conducting Drainage Extension Work in the South," by S. H. McCrory, engineer in charge of rural engineering, Washington, D. C.; "Dynamiting," by P. H. Williams, Memphis.

The closing afternoon of the meeting was devoted to inspection of the experimental work being carried on under the supervision of C. E. Ames, assistant director at the branch experiment station at Holly Springs, Miss. These experiments have to do with reclaiming and conserving land by the use of terraces in connection with certain special devices for preventing erosion.

CHICAGO SAFETY COUNCIL

A series of addresses and instructions in safety principles and practices is to be given to managers, engineers, superintendents, safety department employees and others interested by the Chicago Safety Council, which was organized by the Chicago Association of Commerce.

THE OKLAHOMA HIGHWAY ENGINEERS' ASSOCIATION

The following officers were elected at a meeting held at Oklahoma City: President, Will M. Clarke; first vice-president, Pearl Little; second vice-president, Floyd F. McAlester; secretary-treasurer, Frank Herman.

AMERICAN SOCIETY of MECHANICAL ENGINEERS

The principal topic at the annual meeting of the American Society of Mechanical Engineers, December 7-10, New York City, will be "Transportation," including railroads, waterways, feeders, motor trucks and the terminal problems in New York City.

The professional section topics will include fuels, machine shop, management, railroad, textile, power, wood working, research, design, and miscellaneous subjects. L. P. Breckenridge will speak on the "Fuel Supply of the World." The management section will exploit the life and work of the late Henry L. Gantt. The principal topics of the railroad section will be "Static Adjustment of Tracks on Curves," by R. Eksergian; "Increasing Capacity of 'Old Locomotives," by C. B. Smith, and "Modernizing Locomotive Terminals," by George W. Rink. At the research session D. E. Foster will speak on "The Flow of Fluids through Pipe Lines, and the Effect of Pine Line Fittings." N. W. Akimoff will speak on "Foundations for Machinery."

AMERICAN ASSOCIATION of ENGINEERS

Gardner S. Williams addressed the opening fall meeting of the Ann Arbor Chapter, October 7, on "The Power Possibilities of the Great Lakes-St. Lawrence Waterway." James S. Bowman of the Fargo Engineering Co., Jackson, Mich. spoke of the need for greater restriction in the development of power in the National parks.

Dunsmuir, Cal., has recently organized a chapter with the following officers: L. H. Taylor, president; G. M. Taylor, first vice-president; V. E. Parker, second vice-president; J. G. Standley, secretary-treasurer.

WESTERN SOCIETY OF ENGINEERS

The Journal of this society is to become a monthly beginning with the October issue. It will give less attention to matters of general engineering interest fully covered in the weekly engineering press, give immediate reports of the month's meetings, keep the membership completely in touch with the work of each committee and will contain in full such technical papers as are of certain general interest to the membership, revising and giving abstracts of the others.

PERSONALS

Allen, J. J., director of the research laboratories, American Society of Heating and Ventilating Engineers, has been appointed consulting engineer on ventilation to the chief engineer of the New York and New Jersey commissions in charge of the construction of the Hudson river vehicular tunnels.

Blood, Louis H., formerly chief engineer of the Osterlan Machinery Co., Cincinnati, has opened an office in that city.

Bidwell, Frank, has been appointed executive secretary to Thomas J. Wasser, state highway engineer of New Jersey.

Barde, J. M., is to supervise the construction work on the Carthage section of the Carthage-Carterville concrete road.

Carpenter, L. G., has been employed by the San Diego, Cal., water commission to furnish plans and estimates for converting Dulzura creek into a conduit which will convey the city water supply from Dulzura to Lower Otay.

Calvert, Lt.-Col. L. L., formerly of the construction service, U. S. Army, has returned to his pre-war position as chief engineer with the Tidewater Building Company, New York City.

Calvert, D. Gordan, has been appointed resident engineer in charge of the construction of the Fort William Paper Co., at Fort William, Ont.

Cooper, Sidney W., has been appointed assistant division engineer, 4th division, Alabama Highway department.

Green, A. M., has been appointed engineer of Modac Co., Cal.

Holgate, Henry, consulting engineer, has been retained by the Department of Railways and Canals, Montreal, to report in the power shortage in Trent Valley, Ont., and the development of greater power along the Trent canal by the Hydro-Electric Power Commission of Ontario.

Hoover, Clarence B., has been appointed engineer in charge of the bureau of water works extensions of Columbus, Ohio.

Johnson, Dean A. N., of the college of engineering in the University of Maryland, has been appointed chairman of the National Highway Council of the American Association of Engineers. This council will be organized similarly to the railroad and federal councils of A. A. E.

Lyon, L. E., a civilian member of the army engineer staff in the Norfolk district, has been commissioned a major.

Lanagan, N. H., commissioned major of engineers, has been assigned to the Fifth Regiment at Camp Humphreys.

Lawson, Wilfred S., has been appointed bridge and structural engineer in the Department of Railways and Canals, Ottawa.

Lautz, George H., has been appointed assistant engineer of the U. S. Forest Service, Washington, D. C.

McCabe, J. J., has been appointed general superintendent of a dam at Decatur, Ill.

Merkt, Ol, formerly with Westinghouse, Kerr & Co., has been made assistant chief engineer of the American Can Co., with headquarters in New York.

Newcomer, Col. Henry C., has been appointed division engineer of the U. S. engineer department with headquarters in New Orleans.

Salmond Bros. Co., of Arlington, N. J., have changed their corporate name to Salmond, Scrimshaw & Co.

Scott, J. H., has been appointed division engineer for The Dalles, Oregon state highway commission.

Whittemore, Walter F., has been appointed by Governor Edwards to serve on the State Board of Public Utility Commissioners of New Jersey.

Tuippa, H. M., has accepted a commission as major in an engineer regiment of the U. S. Army.

Weldon R. Lawrence has joined the Fort Frances Pulp & Paper Co., Fort Frances, Ont., as resident engineer in charge of engineering and construction.

Wilson, H. Lee, has been appointed city engineer of Johnstown, Pa.

Washington, Walter, has been appointed city manager of Charlottesville, Va., succeeding Shelton, S. Fife.

Macomber, Grant C., architect and engineer, formerly at 11 Doyle Bldg., Flint, Mich., has taken larger quarters at 616 Genessee County Savings Bank Bldg.

Riley, Lee, hydraulic engineer, has been appointed engineer for the Leavenworth and Fort Leavenworth Water Co., Leavenworth, Kan.

Herr, Hiero B., died at Dillsburg, Pa., September 3.

Jones, Louis B., on the engineering staff of the Maine Highway Commission, died October 12 at Portsmouth, N. H., while attending a conference on the new interstate bridge.

Parker, Philip A. Morley, one of the leading engineers in the Federated Malay States, died at Kuala Lumpur on August 4.

Thompson, Emerson, chief engineer on bridge and canal work for Manning & McDonald, died recently at Spokane, Wash.

Waters, William, formerly of the engineering firm of Baker, Carpenter & Waters, San Francisco, died October 16.

Porter, S. D., city engineer of Peru, Ill., died at LaSalle, Ill., September 12.

Henderson, Ernest G., civil engineer, Windsor, Ont., died October 13.

Cattell, Major William A., consulting engineer, died on October 10.

GEORGE H. INGRAM

George H. Ingram, vice-president of Warren Brothers Company, Boston, died at his residence in Nashville, Tenn., October 28, after a few weeks' illness with typhoid fever. Before his association in 1902 with Warren Brothers Company, Mr. Ingram had organized the Nashville Roofing and Paving Company and was prominent in road building and pavement construction. He took an active part in all the conventions of the American Society for Municipal Improvements. His death is a serious loss to the highway interests of this country.

New Appliances

Describing New Machinery, Apparatus, Materials and Methods and Recent Interesting Installations

CLETRAC

The Cletrac, a light and handy tractor manufactured by the Cleveland Tractor Company, weighs 3,400 pounds, has a speed of 1 to 5 miles per hour, is 96 inches long, 50 inches wide and 52 inches high and is operated by a 4-cylinder motor with 4-inch bore and 5½-inch stroke that develops a draw bar h. p. of 12 and a belt h. p. of 20, with 20 per cent emergency reserve. It is provided with two 50 x 8-inch caterpillar tracks, reducing the load on the ground to 4¼ pounds per square inch.

It is especially recommended for road building operations and it replaces 6 to 8 horses or mules in hauling grading and dragging machines, plows and trailers. It is also useful for general construction work, hauling heavy truck loads over poor roads and extricating them from bad places as well as for handling heavy timbers, moving machinery and even for operating rock crushers and concrete mixers in emergency. It operates well over rough and soft roads and on steep grades, and is of sturdy construction.

It is useful to replace switch engines and spot freight cars for loading and unloading, and is very convenient for hauling heavily loaded trucks over bad roads, and for pulling them out of soft or rough places that stall them when they can pass elsewhere over good roads.

The street commissioner of Union City, Pa., reports that one of these tractors has been used for all road and street work, much of it on unpaved streets, and during the month of September, when it was in service 16 days, the total expense for gas, oil, and other incidentals was $39.80, while the cost of horses for doing the same work would have been $264. The mayor of Athens, Tex., writes that he estimates the saving of a Cletrac over equivalent mule service to be $11 per day.

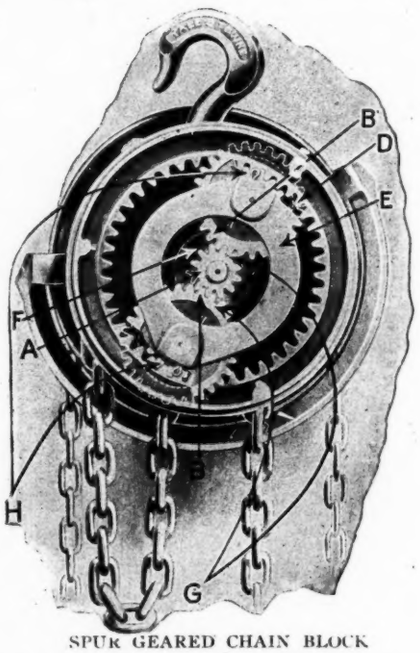
YALE SPUR GEARED CHAIN BLOCK

This hand hoist is especially convenient and efficient for lifting heavy weights of moderate dimensions that have to be frequently raised to a small height where labor is expensive. It is adapted to be used in a fixed position or to be attached to a trolley and is very rapid in operation.

It is built in seventeen sizes of ¼ ton to 40 tons capacity, each of them being tested at the shop by lifting a load of 3,360 pounds per ton rating.

One man pulling 80 pounds on the operating chain easily and quickly lifts a 1-ton load with a minimum friction. The block holds the load wherever it is kept and only lowers it when the chain is pulled for that purpose.

The block, which is here shown with the case removed, is designed on the planetary gear system by which the load is distributed equally on every tooth of every gear and their bearings, thus reducing the wear to a minimum. Pulling the hand chain revolves the sprocket wheel and the pinion A keyed to its axle, thus operating the two intermediate gears BB that mesh into the internal gear D at H and operate the pinion cage E and sheave F which lifts the load. Friction is reduced by roller-bearings, equilibrium is maintained by the balanced pressures no matter what the position of the load, and the whole device is very compact and is protected by the exterior case that encloses all the mechanism.



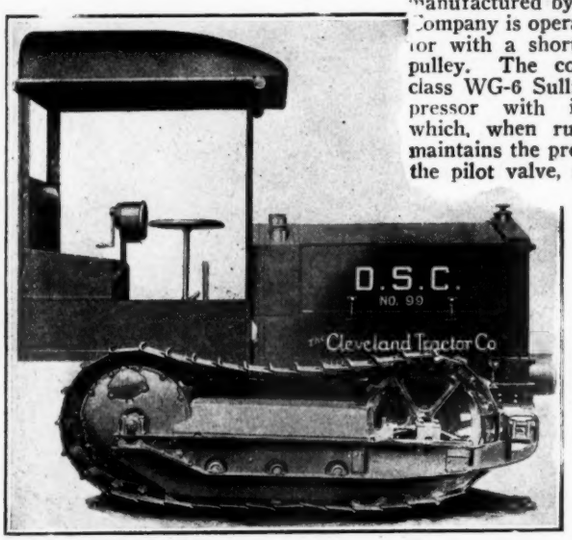
SPUR GEARED CHAIN BLOCK

SULLIVAN PORTABLE AIR COMPRESSOR

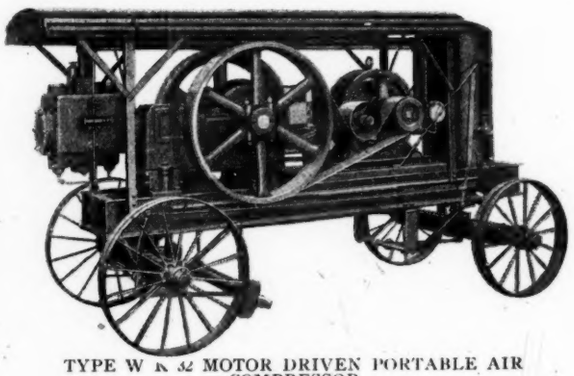
The new type WK-32 air compressor manufactured by the Sullivan Machine Company is operated by an electric motor with a short belt drive and idler pulley. The compressor itself is a class WG-6 Sullivan single-stage compressor with inlet valve unloader which, when run at constant speed, maintains the pressure by the action of the pilot valve, shown on the side of the air cylinder. When the pressure exceeds the required amount the pilot valve raises the inlet valves from their seats and allows the piston to reciprocate without load until the pressure falls and releases the pilot valve.

The inlet and discharge valves are of the improved Sullivan wafer pattern consisting of thin spring-steel rings held in place by springs and providing wide port openings with short valve travel, thus giving excellent volumetric efficiency.

The air cylinder is cooled by a Hopper jacket filled from a bucket. The main working parts are oiled by the splash system. Either direct or alternating current motors can be supplied and the compressors are from 100 to 350 cubic feet of air per minute capacity. The complete equipment is mounted on a structural steel frame or truck and covered by a metal canopy with canvas side curtains.



LIGHT TRACTOR FOR OPERAEING SNOW PLOWS IN NEW YORK



TYPE W K 32 MOTOR DRIVEN PORTABLE AIR COMPRESSOR